

Smoke & Carbon Monoxide Dwellings Alarm Requirements

Smoke alarms and *carbon monoxide alarms* that are properly installed and maintained are an essential part of a home safety program. The placement of fire alarms and carbon monoxide alarms is based on providing a warning to sleeping persons in sleeping areas of a dwelling. The *National Fire Protection Association (NFPA)* has a document called the *Fire Alarm Code (NFPA-72)* that provides installation rules that can be adopted by individual governmental units such as the State of Michigan. Carbon monoxide is a colorless and odorless gas that can cause death of humans and animals by means of asphyxiation. Sources of carbon monoxide can be fuel burning appliances, a fireplace, or an automobile in an attached garage. Rules for placement of carbon monoxide alarms in dwellings is found in the *Michigan Construction Code Act, P.A. 230, Section 125.1504f(1)*. Location placement and installation rules for fire alarms and carbon monoxide alarms in dwellings is explained and illustrated in this *Tech Note*.

Locations of Smoke Alarms: The *Michigan Residential Code MRC®* requires smoke alarms be installed in each bedroom of a dwelling. Additional smoke alarms are required outside each bedroom area. The bedroom area is defined as the part of the dwelling that is between the bedroom and the remainder of the living unit. See *Figure 252.1*. The *MRC®* does not require a maximum or minimum distance the smoke alarm be placed from a bedroom, it is required to be in the *immediate vicinity* of the bedrooms. The most common practice acceptable to the local code official (inspector) is in the hallway leading to the bedroom. Placing them in this position will allow it to detect smoke that could be coming from other portions of the dwelling. Note that in *Figure 252.1* there are two separate bedroom areas. Consequently, a smoke alarm is required outside the bedrooms in each area.

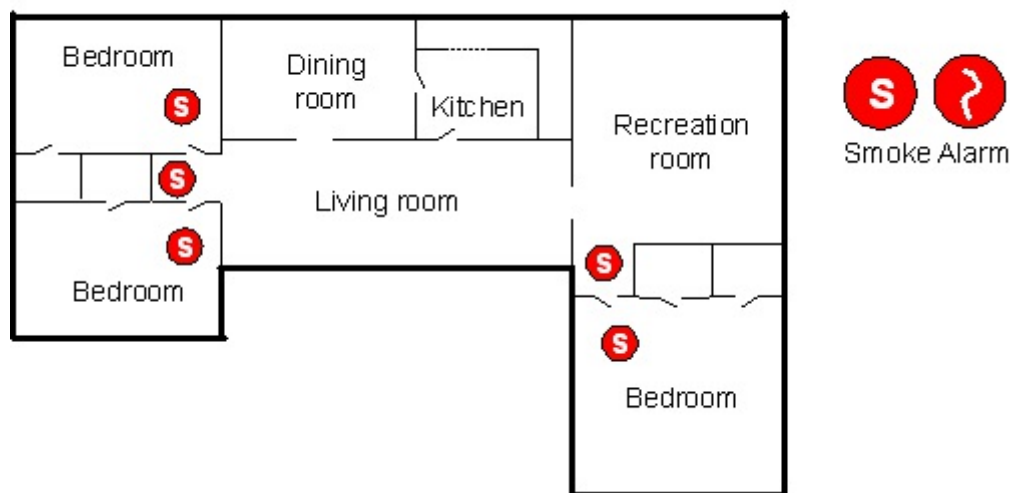


Figure 252.1 Smoke alarms in order to be effective must be placed in each bedroom as well as in the area outside the bedroom area.

In addition to the smoke alarms outside the sleeping areas the *MRC*[®] requires the installation of a smoke alarm on each additional story of a dwelling unit including basements and habitable attics. Smoke alarms are not required to be installed in crawl spaces and uninhabitable attic spaces. Smoke alarms mounted on multiple floors are illustrated in *Figure 252.2*.

To insure proper operation of the device, installation of smoke alarms shall be installed in accordance with the manufacturers' instructions. The *MRC*[®], the manufacturer and *Fire Alarm Code*[®] all place restrictions on their placement to limit nuisance operation. Some areas that manufacturers list to avoid include:

- spaces where the ambient temperatures can fall below 40°F (4°C) or exceed 100°F (38°C).
- garages.
- areas with high humidity.
- close proximity to cooking appliances.
- within 36 inches (0.9m) of a door to a bathroom.
- within 36 inches (0.9m) of any fan or forced air registers.

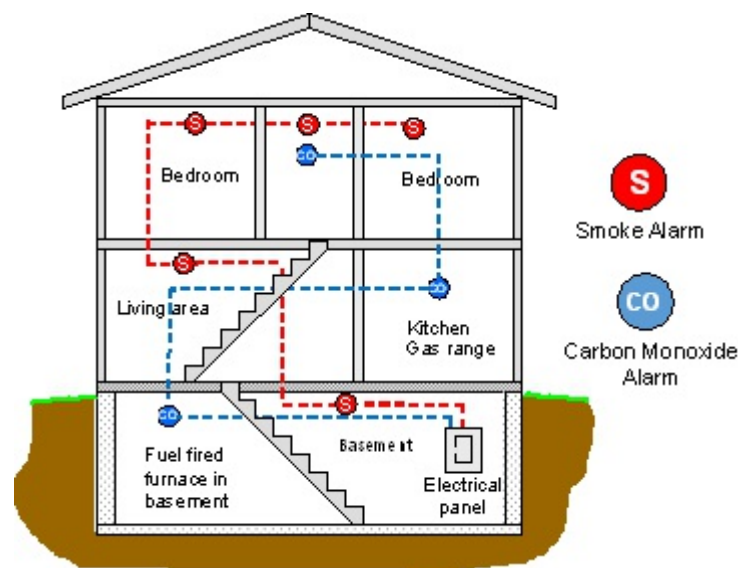


Figure 252.2 Smoke alarms are required on each habitable floor including basements.

To increase protection of inhabitants and increase fire detection capabilities, *heat alarms* can be placed in areas where nuisance operation of smoke alarms may be a concern. Heat alarms provide an audio and/or visual alarm when high temperatures are detected. These devices can be positioned near areas such as fireplaces and cooking equipment where a typical smoke alarm would be prone to annoyance alarms.

The *Fire Alarm Code*[®] suggests placement of smoke alarms in certain locations to maximize their effectiveness at providing an early warning in the event of a fire. The areas that smoke alarms are suggested to be installed include:

- in the path of egress from the dwelling in the event of a fire.
- at the top of stairways where doorways or other obstructions would temporarily prevent the passage of smoke.
- near the bottom of a basement stairway.

Basement smoke alarms should be positioned relative to the stairway so as to intercept smoke coming from a fire in the basement before the smoke enters the stairway. When the basement has an open-joint ceiling the detector should be placed at the bottom of the joist where the alarm is free from obstructions.

Placement of Smoke Alarms: The placement of smoke alarms is critical if maximum speed of fire detection is desired. Thus a logical location for a detector is in the center of the ceiling. However this is not a requirement by the *Fire Alarm Code*®. A more typical location is in an off-centered location on the ceiling. The smoke from a fire generally rises to the ceiling spreads out across the ceiling surface, and begins to bank down the walls. The corner where the ceiling and the wall meet is an air space into which the smoke could have difficulty penetrating. In most fires this *dead or stagnant air space* measures four inches along the ceiling from the corner and about four inches down the wall as shown in *Figure 252.3*. Smoke alarms are not permitted to be installed in this dead or stagnant air space.

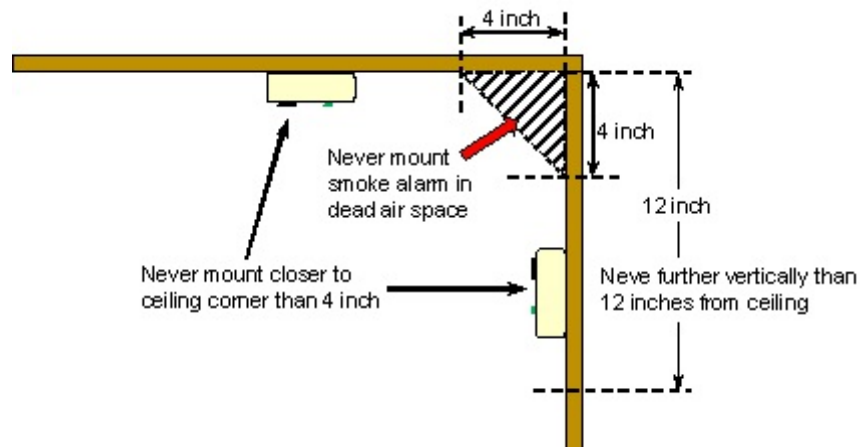


Figure 252.3 Smoke alarms are permitted to be installed on ceilings and walls. Mounting must not be in an area where dead or stagnant air space will impede smoke detection.

Smoke alarms are permitted to be installed on walls. Because of the convection currents of air along cool surfaces place smoke detectors on the interior walls of a dwelling rather than on exterior walls. Placing smoke detectors on the interior walls will result in a detector having a quicker response time than one placed on an exterior wall. If placed on walls, the *Fire Alarm Code*® does not allow smoke alarms to be located more than 12 inches below the ceiling.

Dead air spaces can also be found on sloped and peaked ceilings. Examine *Figure 252.4* for the permitted placement of smoke alarms for these ceilings. For peaked ceilings, smoke alarms must be located within 36 inches of the peak but no closer than 4 inches vertically of the peak. For sloped ceilings smoke alarms must be located within 36 inches horizontally of the *high side* of the ceiling, but no closer than 4 inches vertically of the highest ceiling point. Always check the manufacturers instructions for proper mounting requirements.

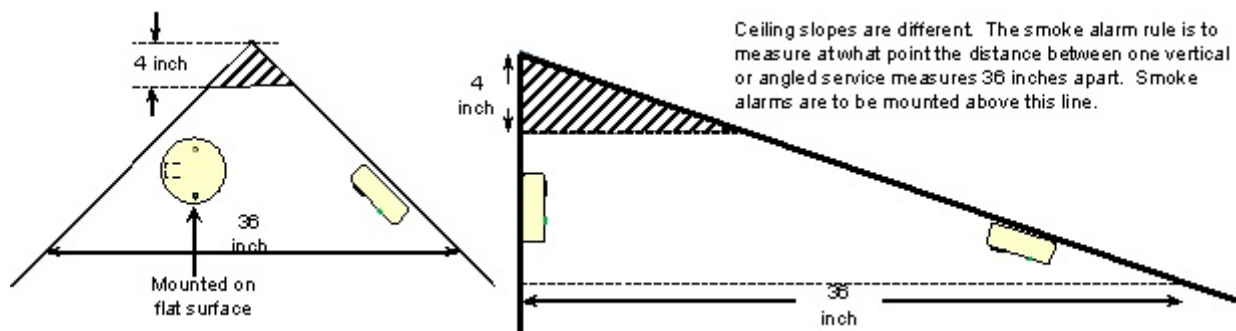


Figure 252.4 Smoke alarms are not permitted to be installed in the dead air spaces near corners of peaked and sloped roofs or ceilings.

Wiring of Smoke Alarms: For dwelling units the *MRC*[®] requires a certain type of alarm be installed. In most cases, for new construction smoke alarms must have two sources of power. Typically the two power sources are 120 volt ac and a battery back-up. The battery back-up provides protection in the event of a power outage. In addition to the two power sources the detectors must be interconnected. When one of the smoke detectors sets off its alarm all of the other detectors in the dwelling unit will also sound an alarm. This interconnection helps all areas of the occupancy to be notified when a single alarm is activated. To achieve this many smoke alarms have an interconnect lead to set off all of the other alarms. See *Figure 252. 5*. Consult the manufacturers instructions for the maximum number of interconnected alarms.

Some smoke alarms use wireless technology to communicate to other alarms within range. Typically these types of alarms have a number of pre-set communication frequencies to select from to help prevent activation from other neighboring alarm systems or other wireless equipment.

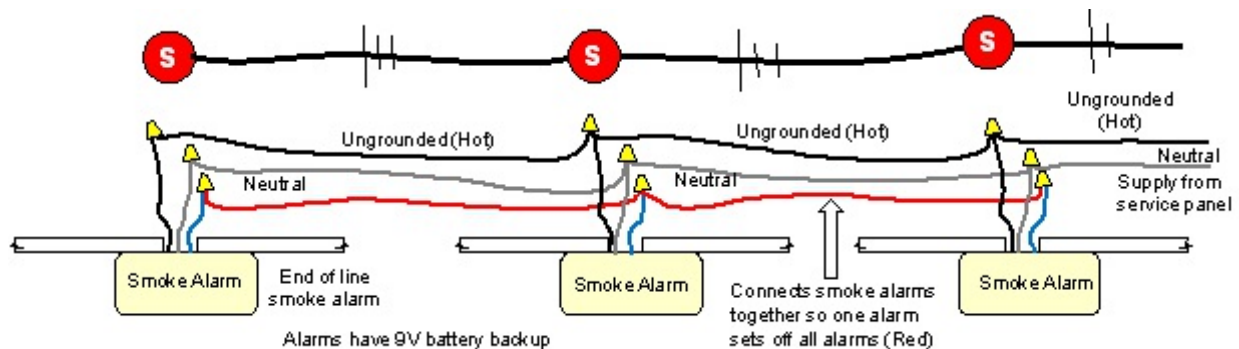


Figure 252.5 Smoke alarms are required to have a battery back-up and be interconnected resulting in all of the smoke alarms in the dwelling at once.

Smoke alarms are supplied power by activating 15- or 20-ampere rated 120 volt circuits. For a 15-ampere circuit with alarms wired as shown in *Figure 252.5*, nonmetallic-sheath cable, type NM-B 14-2 with ground is run to the first smoke detector and type NM-B 14-3 with ground is run between the alarms. If the circuit is 20-ampere rated the circuit wire must be at least a size 12 AWG conductor. The alarms can be supplied by a dedicated circuit or they may be connected to any general purpose circuit.

Smoke Alarms in Existing Buildings: The *MRC*[®] requires smoke alarms installations for certain existing buildings. If a permit is required for work inside an existing dwelling or a bedroom is added to a dwelling the *MRC*[®] requires the dwelling unit to be equipped with smoke alarms located and wired as required for a new dwelling. The following installations do not require the dwelling be brought up to the smoke alarm mandates for a new dwelling:

- replacement of roofing or siding.
- replacement or addition of windows or doors.
- porch additions.
- installations, alterations or repairs of plumbing or mechanical systems.

Carbon Monoxide Alarms: Carbon monoxide (CO) poisoning occurs when carbon monoxide gas is inhaled. Carbon monoxide is a colorless, odorless, highly poisonous gas that is produced by incomplete combustion. It is found in automobile exhaust fumes, faulty stoves, fuel-fired appliances and heating systems. Sources include wood-burning stoves, gas or fuel heaters, improperly ventilated fuel-fired water heaters, gas stoves and blocked or poorly maintained chimney flues. CO interferes with the ability of the blood to carry oxygen. The result is headache, nausea, convulsions and finally death by asphyxiation.

When considering where to place a carbon monoxide detector keep in mind that although carbon monoxide is roughly the same weight as air it may be contained in warm air coming from combustion appliances such as home heating equipment. If this is the case, carbon monoxide will rise with the warmer air. Installation locations vary by manufacturer. Therefore, make sure to read the provided installation manual for each detector before installing. In most cases for new construction carbon monoxide alarms must have two sources of power. However, carbon monoxide alarms are not required to be interconnected like smoke alarms.

Required Installation of Carbon Monoxide Alarms: For new construction the *MRC*[®] requires carbon monoxide alarms be installed in dwelling units which have fuel-fired appliances and/or have an attached garage. There are combination styles of smoke alarms available where a single unit will detect the presence of smoke or carbon monoxide. One thing of note, the *MRC*[®] does not specifically state where carbon monoxide alarms must be placed. This requirement is found in the *Michigan Compiled Law 125.150f of Public Act 230 of 1972*. This public act is commonly referred to as the Construction Code Act. As Public Act 230 of 1972 is currently amended. If a carbon monoxide alarm is required for a dwelling, they must be located in the immediate vicinity of the bedrooms in areas of the dwelling that are adjacent to an attached garage and in areas adjacent to a fuel-burning appliance.

For some circumstances the *MRC*[®] requires carbon monoxide alarms to be installed in an existing dwelling. If a building permit is required for any work at an existing dwelling that has fuel-fired appliances and/or an attached garage carbon monoxide alarm(s) are required. *Figure 252.6* shows the required placement of carbon monoxide alarms. The carbon monoxide alarm placement is summarized in *Figure 252.6*.

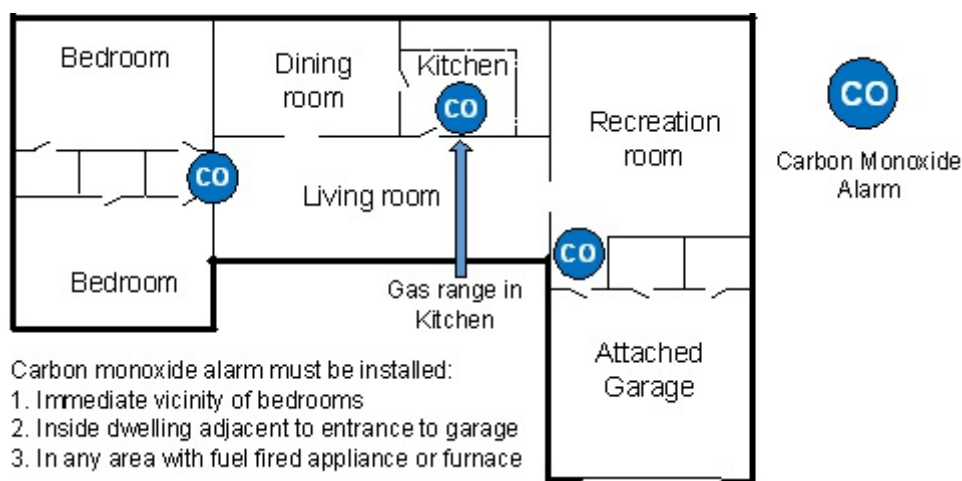


Figure 252.6 Carbon monoxide alarms are required for dwellings that have attached garages or contain fuel-fired appliances.

Types of Smoke Detectors: There are two types of smoke alarms available photoelectric and ionization. *Ionization detectors* are the most common and often least expensive detectors available. This detectors' smoke chamber contains a radioactive source that emits radiation resulting in a weak flow of electric current. When particles such as those produced by fire enter the smoke chamber they detect the current and trigger the alarm. This type of detector is generally most effective in detecting the "characteristics of combustion" produced during the beginning stage of a fire. Although early detection is always desirable there are several inherent flaws with this technology. For example ionization detectors may be activated by the particulates in the air from cooking food. Another downfall is their general susceptibility to false alarms that have a tendency to become more than a minor nuisance once the fire department is dispatched.

Unless it would prevent the installation of a required smoke alarm the *MRC*[®] prohibits the installation of ionization smoke alarms within 20 feet of a permanently installed cooking appliance. This distance is decreased to 10 feet if the alarm has a switch that can silence the alarm.

Photoelectric detectors although not effective in detecting the invisible gases created during the beginning stage of a fire are generally more stable and reliable when it comes to false alarms. Photoelectric detectors are far superior at detecting visible smoke that may not contain the invisible gases required to set off an ionization detector. There are two types of detection methods within the photoelectric type, *obstruction* and *light scattering*. Obstruction involves the interruption of a beam of light, while light scattering utilizes the light diffusing properties of smoke to redirect a beam of light to a light sensor. Both are effective, however, the obstruction type detector requires more smoke to activate than the light scattering type. Unless it would prevent the installation of a required smoke alarm, the *MRC*[®] prohibits the installation of photoelectric smoke alarms within 6 feet of a permanently installed cooking appliance.

Fireblocking: A fire requires fuel, an ignition source, and oxygen to thrive. Fire-blocking helps minimize the spread of fires inside concealed wall spaces by trying to deprive a fire of oxygen. Fire-blocking attempts to form an effective fire barrier between different floors of a dwelling.

In concealed spaces of wood-frame constructed dwellings, openings that allow for a draft between floors must be fire-blocked according to the *MRC*[®]. Openings at ceiling or floor levels where a cable, raceway or conduit that passes through to another level of the structure are required to be fire-blocked. *Figure 252.7* illustrates vertical locations for fire-blocking. Fire-blocking can be achieved by using an approved material such as caulk or spray foam to form an effective seal around wiring material passing through a construction bored opening.

Also in concealed spaces of walls horizontal installations of cable or raceway may require fire-blocking. If a cable or raceway is installed in horizontally through holes in a concealed wall space that exceeds 10 feet fire-blocking is required. The installation of an approved caulk or spray foam to seal a horizontal installation of cable or raceway is required at intervals of 10 feet.

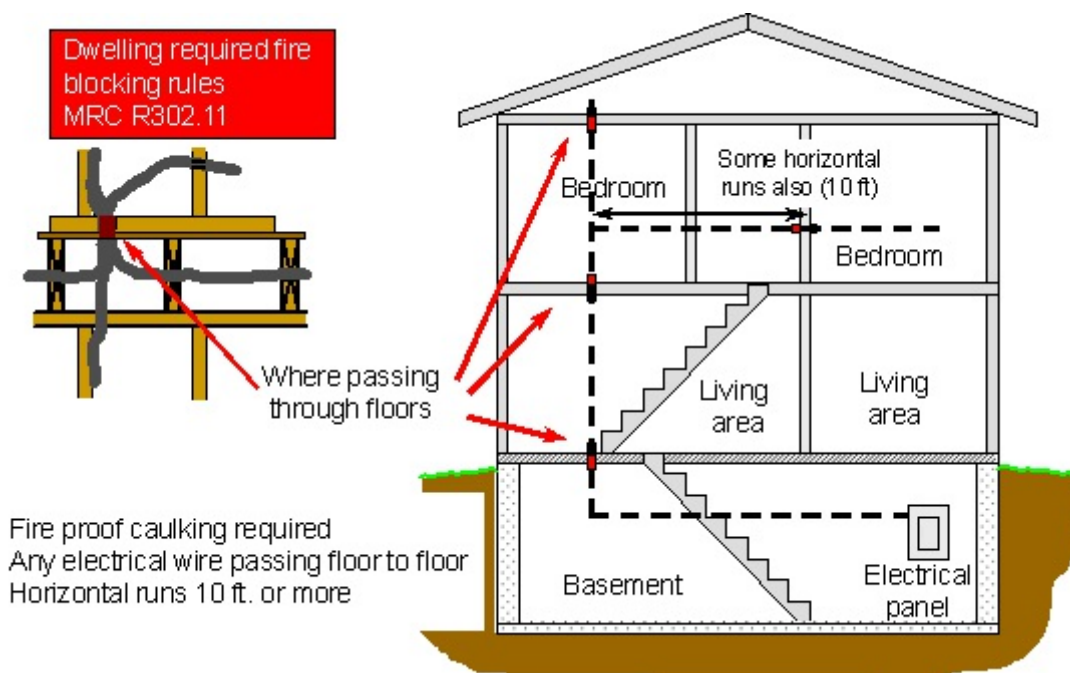


Figure 252.7 Fire-blocking is required where a cable, raceway or conduit passes through to another level of the structure in the concealed spaces of a wood-frame dwelling.